

## WHAT IS CLAIMED IS:

1. A method for recovery from failures affecting a primary copy of a data repository, for use in a data processing system in which updates applied to the data repository during normal forward processing are applied within transactional units of work, the method including the steps of:

storing a secondary copy of data representing data items held within the data repository and updates applied to the data repository within said units of work;

in response to a failure affecting a primary copy of the data repository, identifying from said secondary copy a set of operations required for restoring said data items and applied updates to a primary copy of the data repository;

determining the state, at the time of the failure, of each unit of work corresponding to one or more operations of the identified set of restore operations; and

performing restore operations of said identified set for which said performance is consistent with the determined state of the corresponding unit of work, and discarding restore operations of said identified set for which performance is inconsistent with the determined state of the corresponding unit of work.

2. A method according to claim 1, including the steps of:

saving to a cache a subset of said secondary copy of data, which subset corresponds to the identified set of operations required for restoring said data items and applied updates;

5           and wherein, subsequent to the step of determining the state of each unit of work, the step of performing restore operations comprises applying restore operations from said cache.

10       3.    A method according to claim 2, including the step of deleting from the cache the restore operations for which the corresponding unit of work is determined to be neither committed nor in-doubt, thereby to discard said restore operations for which performance is inconsistent  
15       with the determined state of the corresponding unit of work, when performing restore operations.

          4.    A method according to claim 1, wherein the step of performing restore operations includes the steps of:  
20           performing restore operations for which the corresponding unit of work is determined to be committed; and

          performing restore operations for which the corresponding unit of work is determined to be in-doubt,  
25       and marking the data item to indicate that the unit of work is in-doubt.

          5.    A method according to claim 2, including the step of deleting from the cache any pairs of updates within the  
30       set of restore operations, which pair of updates

correspond to addition of a data item and retrieval of the same data item and which pair of updates was completed prior to the failure, thereby to discard said pairs of updates when performing restore operations.

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6. A method according to claim 1, wherein storing the secondary copy comprises storing a backup copy of the data repository and storing log records describing updates to the primary copy performed since the backup copy was stored; and wherein the step of identifying said set of operations comprises replaying the log records to identify operations performed on the primary copy of the data repository.

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7. A method according to claim 1, wherein storing the secondary data copy includes maintaining log records that describe operations performed on data items within the data repository, and wherein the step of restoring data to the primary copy of the data repository includes the steps of:

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replaying the log records of operations performed on data items within the data repository,

caching log records relating to operations performed on data items within the data repository within an original unit of work,

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determining from the cached log records the state of the original units of work at the time of the failure, and

determining, for said operations having cached log records, which operations to perform within the recovery

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unit of work based on the determined state of the original units of work.

5       8.    A method according to claim 1, wherein the data repository is a message repository and the step of restoring data to the primary copy of the data repository comprises performing message add, update and delete operations on the message repository.

10       9.    A method according to claim 8, for performance within a messaging communication system, wherein maintaining the secondary data copy includes storing log records to describe updates to the primary copy, and wherein the step of restoring data to the primary copy of  
15       the repository includes the steps of caching log records relating to message add, update and delete operations performed under syncpoint control within an original unit of work, determining from the log records the state of the original unit of work at the time of the failure, and  
20       determining the operations to perform within the recovery unit of work based on the determined state of the original unit of work as follows:

25           if the original unit of work is committed, performing the relevant message add, update and delete operations; and

          if the original unit of work is in-doubt, performing the relevant message add, update and delete operations but marking the operations in-doubt; and

30           if the original unit of work is neither committed nor in-doubt, discarding the cached operations.

10. A data communication system including:

data storage for storing a primary copy of a data repository;

secondary data storage for storing a secondary copy of data representing the data repository which secondary data is sufficient to recover the primary copy of the data repository and data held thereon;

a recovery component for controlling the operation of the data communication system to recover from a failure affecting the primary copy of the data repository, wherein the recovery component is operable to control the data communication system to perform the steps of:

in response to a failure affecting a primary copy of the data repository, identifying from said secondary copy a set of operations required for restoring said data items and applied updates to a primary copy of the data repository;

determining the state, at the time of the failure, of each unit of work corresponding to one or more operations of the identified set of restore operations; and

performing restore operations of said identified set for which said performance is consistent with the determined state of the corresponding unit of work, and discarding restore operations of said identified set for which performance is inconsistent with the determined state of the corresponding unit of work.

11. A data communication system for transferring  
messages between a sender and a receiver, the system  
including data storage for storing a primary copy of a  
message repository and including secondary data storage,  
5 wherein messages are held in the primary copy of the  
message repository following a message send operation and  
are retrieved from the primary copy of the message  
repository for delivery to the receiver, and wherein a  
secondary copy of the message repository is stored in the  
10 secondary data storage and log records are written to  
record message send and message retrieval events  
performed within transactional units of work since  
creation of the secondary copy,

the system including a recovery component adapted to  
15 control the data communication system to perform the  
following steps:

in response to a failure affecting a primary copy of  
the message repository, identifying from said secondary  
copy a set of operations required for restoring said  
20 messages and reapplying message send and retrieval  
operations to a primary copy of the message repository;

determining the state, at the time of the failure,  
of each unit of work corresponding to one or more  
operations of the identified set of restore operations;  
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performing restore operations of said identified set  
for which said performance is consistent with the  
determined state of the corresponding unit of work, and  
discarding restore operations of said identified set for

which performance is inconsistent with the determined state of the corresponding unit of work.

12. A computer program product comprising program code recorded on a recording medium for controlling the operation of a data processing apparatus on which the program code executes to perform a method for recovering a data repository from a failure affecting a primary copy of the data repository, for use with a data processing apparatus having a secondary data storage and having a component for maintaining a secondary copy of data in the secondary data storage which secondary copy is sufficient to recover the primary copy of the data repository and data items held thereon, and wherein updates applied to the data repository are applied within transactional units of work, the method including the steps of:

in response to a failure affecting a primary copy of the data repository, identifying from said secondary copy a set of operations required for restoring said data items and applied updates to a primary copy of the data repository;

determining the state, at the time of the failure, of each unit of work corresponding to one or more operations of the identified set of restore operations; and

performing restore operations of said identified set for which said performance is consistent with the determined state of the corresponding unit of work, and discarding restore operations of said identified set for

which performance is inconsistent with the determined state of the corresponding unit of work.

13. A recovery component for recovering a data repository from a failure affecting a primary copy of the data repository, for use with a data processing system having primary and secondary data storage and having a component for maintaining a secondary copy of data in the secondary data storage which secondary copy is sufficient to recover the primary copy of the data repository and data items held thereon, wherein updates applied to the data repository are applied within transactional units of work, the recovery component being adapted to perform a method including the steps of:

in response to a failure affecting a primary copy of the data repository, identifying from said secondary copy a set of operations required for restoring said data items and applied updates to a primary copy of the data repository;

determining the state, at the time of the failure, of each unit of work corresponding to one or more operations of the identified set of restore operations; and

performing restore operations of said identified set for which said performance is consistent with the determined state of the corresponding unit of work, and discarding restore operations of said identified set for which performance is inconsistent with the determined state of the corresponding unit of work.